

not excessive for a summer thunderstorm, the temperature of 0°C . will be encountered at an altitude of not less than 3,000 meters and often more.

To return to the action of "niagaras" on hail; I will cite only three cases, taken from localities where the observations are unquestioned.

Since a "niagara" was installed on the Eiffel Tower, the falls of hail have not been less frequent than formerly in the quarter of the Champ-de-Mars and especially at the Bureau Central Météorologique [near the base of the Tower], where they have been observed and recorded with the greatest of care. The complete list of hail falls can be published, if necessary.

The lower station of the Observatoire de Puy-de-Dôme is situated in a freely exposed location on a plateau, in the suburbs of Clermont-Ferrand. A steel skeleton tower (pylône en fer) 31 meters high, has been constructed to carry the anemometers and is equipped with a "niagara." In the annual report of the director we read that hail fell twice on the "niagara" in 1912 and four times in 1913. Particularly on August 29, 1913, the hailstones averaged the size of a pigeon's egg and were sometimes the size of a hen's egg. Mr. Mathias concludes from his observations that "the hail-dispelling ability of the 'niagara,' theoretically improbable, has not been experimentally demonstrated."

Still more instructive observations are those of the Observatoire de Bordeaux, situated at Floirac, which was provided with a "niagara" September 22, 1912. The commune of Floirac was devastated by hail on August 15, 1887; but for the succeeding 25 years it had been immune. Again in 1912, two disastrous falls of hail occurred at Floirac, one on July 5, before the installation of the "niagara," the second on October 20, when a heavy shower of very large, hard hailstones fell upon the "niagara" itself during a period of two and a half minutes. Stones picked up 35 minutes after the fall were found to be spherical in form and opaque and on an average the size of a small pea. One of the observatory officials collected and sketched a number of very remarkable forms of hailstones that had fallen at the foot of or within less than 40 meters of the steel tower of the "niagara."

These observations show how necessary it is to be conservative in expressing appreciation of the efficiency of hail-fighting apparatus. Because there has been no hail in a place, one has no right to conclude that the processes employed, cannons, rockets, or "niagaras," have prevented the hail. A region devastated by hail may be spared for 25 years, although not supplied with any form of protection, and hail may visit it again twice in the same year a paragrêle is installed at that place.

Under these conditions, I should not recommend the extension of the system of electric "niagaras;" in my opinion there are already more than enough to continue observations which, it seems to me, must inevitably lead to negative conclusions.

On the contrary, it will be very important to have numerous exact observations on the falls of hail in France. At the present time the available stations do not enable us to draw charts showing the distribution of hail, that are sufficiently detailed to be valuable. I pointed out this insufficiency more than 10 years ago in studying the storms of 1903, and I have shown that in order to make a complete study of the distribution of hail over a small Department like the Rhône, it would be necessary to have from 280 to 300 stations uniformly distributed. A large Department like the Gironde or the Dordogne would need about 1,000 stations. These numbers suffice to show the difficulties of the problem.

A NEW TURBIDIMETER.

By P. V. WELLS.

[Dated U. S. Bureau of Standards, Apr. 29, 1914.]

[Author's abstract.]

A systematic study of turbidity for the purpose of defining a proper standard is much needed. The paper describes an instrument in which the turbidity is measured by the light diffracted from the particles. A collimated beam from an intense source such as a Nernst or tungsten filament passes through a variable thickness of the turbid medium, and is totally reflected by a prism, thence forming a uniform beam in one field of a photometer. The diffracted light is not totally reflected, but is refracted by the prism into the other aperture of the photometer. Thus the reading is a function of the ratio of the intensities of the light scattered and transmitted, which, in turn, varies with the turbidity.

The instrument is adapted to liquids, gases, and solid plates. Minute traces are measurable with photometric precision, while the range is widened by varying the thickness of the medium. The characteristics of a preliminary instrument constructed at the Bureau of Standards are discussed.

In connection with the above, Dr. S. W. Stratton, Director, United States Bureau of Standards, writes: "It may be of interest to know that the bureau is planning to use a form of the instrument in the study of fogs as a part of the work of the [International] Ice Patrol."

THE LOWEST TEMPERATURE OBTAINABLE WITH SALT AND ICE.¹

By ROSS AIKEN GORTNER, Physiological Chemist.

[Dated, Carnegie Instit. of Washington, Dept. Exper. Evolution.]

* * * While discussing freezing mixtures with a friend recently I stated that a temperature of -19°C . could be easily obtained and maintained for some hours with an ice and salt mixture. My friend questioned the accuracy of the thermometer, inasmuch as -19°C . is below 0°F . (-17.78°C). I have, therefore, made a careful test to ascertain whether an ice and salt mixture may not show a lower temperature than 0°F .

About a gallon of finely chopped, hard ice was mixed with a quart or more of coarse salt in a water-tight wooden box, the wooden box being used because of the insulation which it afforded. The temperature was then observed with five thermometers. * * *

Thermometers 1, 2, and 3 ["Anchutz normal"] gave the same temperature for the ice and salt mixture, i. e., -21°C ., which is the equivalent of 5.8° below zero Fahrenheit. Thermometer 4 was graduated only to -19°C ., and the mercury was some distance below the bottom of the scale. A reading of -20° to -21°C . was made [by extrapolation]. Thermometer 5 gave a minimum of -4°F ., while the Weather Bureau [minimum] thermometer (No. 6) gave a reading of -5°F . [-20.56°C].

Previous to this experiment I had filled a wooden box holding perhaps 30 pounds of ice with a freezing mixture in the evening and placed it in an empty ice box to

¹ Extract from an article in Science, New York, Apr. 17, 1914, (N. S.), 38, p. 584-585.

conserve ice. In the morning I noted a temperature of -19° C. [-2.2° F.].

From these experiments I am convinced that 0° F. is not "the lowest temperature obtainable with ice and salt." Just what the "lowest temperature" is I am unable to state, having failed to secure a greater lowering than -21° C. Theoretically the lowest temperature should be the cryohydric point (-22° to -23° C.), where the cryohydrate, ice and salt, containing 23.6 per cent of NaCl, separates.

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THE MOTION OF THE SOLAR ATMOSPHERE.

Meteorologists have long been interested in the studies of the solar atmosphere by astronomers; hoping therefrom to derive some suggestions that may contribute to our knowledge of the earth's atmosphere. One of the most interesting points of resemblance between the atmospheres of the sun and the earth has recently been published by the Observatory of Zurich.¹ It is an elaborate study by Wilhelm Brenner on the proper motions of groups of sun spots, which perhaps is the same thing as the motion of the sun's atmosphere within a region of sun spots. He first determines the accuracy of the heliographic positions of the spots within that region. Of course, the general movement of the region has long been understood as corresponding to that of our hurricanes in our Northern and Southern Hemispheres. But within each group of spots there is a divergence of motion among the individual spots corresponding very closely to the outflow of atmosphere from our own regions of high pressure. In other words, the fragments diverge from each other, separating as they are removed from the center of the region, and also rotating anticlockwise in the Northern Hemisphere. Every new increase in the activity of any given group is accompanied by an increase in the divergence of the spots, but this increase is rather feeble than it was when the group of spots first began to develop. This was true in 90 per cent of the groups investigated.

It seems probable that the strength of the divergence depends upon and may be proportional to the energy of the development of the group. In fact Brenner has every reason to believe that there is no connection between the magnitude of the divergence within any spot and the activity of the so-called 11-year period, or with the heliographic latitude.

The possible connection between Brenner's results and certain analogous phenomena consists in the interesting fact that his results agree with the hypothesis that each spot, large or small, and each group of spots, is an eruption or boiling up from within the solar atmosphere. This causes a heaping up over the boiling region, above which the solar gases with their dark and bright spots, flow slowly outward and downward with the anticyclonic whirl without seriously affecting the general motion of the group across the solar surface.—[C. A.]

551.594.221

LIGHTNING AT MOUNT WILSON OBSERVATORY.

By WENDELL P. HOGE, Night Assistant.

[Dated Mount Wilson, Cal., Mar. 30, 1914.]

Yesterday, Sunday, March 29, at 3:30 p. m., the mountain top [elevation, 5,886 feet] was in the midst of a severe snowstorm following a light rain during the forenoon.

Fog covered the mountain. Temperature about 31° F.; wind 12 to 15 miles from the southeast. The wind had risen from very light to brisk about 1 p. m. I was sitting near a window in a one-story concrete metal-roofed building known as the observatory laboratory and study. While the snow was falling quite rapidly in moderate-sized flakes, a rather bright flash of lightning came, followed after an interval of between one-fourth to one-half of a second by a single, short, sharp report quite similar to that of a .22 rifle shot. Then absolute silence. In about five minutes a second flash came, much brighter than the first. This was accompanied instantly by a rather faint very sharp crack, very similar in sound to the spark frequently produced in the laboratory. Then silence again. No more flashes were noticed. Such bright flashes of lightning with such exceedingly wild reports following, I have not before experienced.

POPULAR MISCONCEPTIONS.

Nearly every day brings to the attention of the Editor renewed evidence of the need of education; the abundance of ideas, the rashness of hasty statements, in conversation, in the daily press, and in letters from fellow citizens who wish their ideas to be tested by some expert. In general, these crude notions have occurred to active minds who wish to inquire into the ways of Nature and yet are not willing to accept the principles of research—principles and axioms that have been long since well established. It would seem that a large fraction of mankind is still in the condition of mind that characterized the world before the days of Copernicus, Galileo, and Isaac Newton. It was Columbus who first practically endeavored to verify his theory that the world was not flat but a sphere, and Magellan completed the demonstration. It was Copernicus who maintained that the earth revolved daily on its axis and annually around the sun, and gave a satisfactory demonstration of the truth of his theory. It was Galileo who maintained that bodies fall toward the earth by gravitation and demonstrated the accuracy of his idea. It was Sir Isaac Newton who maintained that this gravitation was universal and that the sun held the earth in its annual orbit, and that the earth held her moon in its monthly orbit, and gave a satisfactory demonstration of the correctness of this idea. And so we might trace the progress of knowledge from those early days down to the present time. Step by step those who have climbed the hill of science have perceived the possibility of some deeper insight into Nature and have been able to demonstrate some new principle. In every case, however, it has been necessary for the respective discoverer to appreciate whatever had already been discovered bearing on the points that he was especially interested in, before he could feel prepared to make additional progress in our knowledge of Nature. The consciousness that we are but beginners in the study of an almost infinite series of problems should make one very modest in his assertions as to how Nature must operate, or how the world was made, or what the possibilities of Nature ought to be. The pathway of science within the past 300 years is strewn with tens of thousands of suggestions that have fallen by the wayside and are long since forgotten; they have helped to show us what does not take place and what is not true and have thus paved the way, and eased the path, of those who have discovered what is true.

Our numerous correspondents must not be surprised or chagrined if in reply to the theories that seem to them

¹ Publikationen der Sternwarte des eidg. Polytechnikums zu Zurich. Bd. 5.